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Biogas Technology: An Approach Towards Healthy Environment

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Introduction : Energy plays very significant role in our day to day activities. Today's energy sources are mainly fossil fuels based which are not only limited but also creates Global Warming. Effect of environment, economic, social and technical factor have led the rapid deployment of various sources of Renewable Energy.

India had power installed capacity of about 245GW out of which renewable contributes 12%. Of the current total renewable energy base, biomass constitutes about 11.5%. Biomass refers to biodegradable material originating in land and aquatic environments including algae, trees and crops or from animal manure.Traditionally, biomass had been utilized through direct combustion. Cow dung cake is one of the most important and widely used biomass for the production of daily energy needs. It has been estimated that 2.5 billion people around the world are not being able to access the modern fuels[1]. They are highly dependable on locally available wood and cow dung cakes. Burning of biomass or cowdung cakes through direct combustion creates indoor air pollution and ultimately contributing to serious health problems, particularly cancer and respiratory infections.

Biogas Technology

Biogas comprises of 60-65 percent methane (CH4), 35- 40 percent carbon dioxide (CO2), 0.5-1.0 per cent hydrogen sulphide (H2S) and traces of water vapours[2]. It is almost 20 percent lighter than air. Biogas cannot be converted into liquidlike liquefied petroleum gas (LPG) under normal temperature and pressure. The slurry coming from digester is rich in nitrogen which is a essential nutrient for plant growth.

Biogas is an easy and healthy cooking fuel since methane emissions from untreated cattle dung and biomass wastes can also be avoided. Since there is no pollution from biogas plants, these are one of the most potent tools for mitigating climatic change and being earth saviours.

Properties

Biogas is a non-toxic, colorless and flammable gas.

It has an ignition temperature of 650 – 750 °C.

Its density is 1.214 kg/ m3

About 60 percent methane and 40 percent CO2 content

Calorific value is 20 MJ/m3(4700 kcal).

Almost 20 percent lighter than air

It liquefies at a pressure of about 47.4 kg/cm2 at a critical temperature of - 82.1°C.

Purified biogas (bio-methane) has a higher calorific value in comparison to raw biogas[3].

Major Application Areas:

Communities and households

Use of biogas technology in India is observed more in domestic sector rather than large scale productions. Thousands of rural and village households in India have adopted biogas as a fuel for cooking, lighting and motive power generation[4] as shown in fig.1.

Fig.1. Various applications of biogas technology.

Cow dung is the common waste used for production of biogas in most of villages. Against an estimated potential of 12 million family type biogas plants overabout 49.6 lakh household size biogas plants have been installed since the inception of the biogas programme in the country[5],[6]. The State-wise details of biogas plants installed since inception till up to 2016-17 as per reported by MNRE, GoI, New-Delhi are given below Table.1 and shown in fig.2.

The households beneficiaries particularly women and children are also getting benefits in terms of reducing drudgery and saving in their valuable time, otherwise spent in collecting fuel wood from long distances/ forests. The independent evaluation study of the National Biogas and Manure Management Programme implemented during 11th five year plan period brought out that about 92% of the beneficiaries expressed their opinions that there was reduction in daily saving of time by 3 hours for a woman, who will go for collecting fire-wood meeting the cooking fuel requirements[6],[7].

Being self reliant for energy generation has also enhanced the productivity of agricultural sector. Alternatively, the biogas technology also aids in developing organic manure for the crops, and is being used by many farmers. The organic manure is derived in the form of slurry, which offers a better nutrient quotient, and it also acts as an excellent soil conditioner.

Biogas for the production of electricity

Although the use of biogas in the production of electricity is a relatively new concept to be adopted in India, it is quickly picking up pace. Recently many organic waste treatment plants have been initiated in most cities. Waste generation rate in Indian cities ranges between 200 - 870 grams/day, depending upon the region's lifestyle and the size of the city. The per capita waste generation is increasing by about 1.3% per year in India. Municipal solid waste generated by the states and union territory is shown in Fig.3. Municipal solid waste (MSW) is treated to generate biogas for the production of electricity. Liquid and solid organic waste of various industries is producing biogas for generating power[6], [7], [8].

Present Status and achievement: Near about 5 million family sized biogas plants of 1-6m3 capacities have so far been installed in the country since 1982-83 under National Biogas and Manure Management Programme being implemented by Ministry of New and Renewable Energy (MNRE), Govt. of India. MNRE approved Biogas plants are mainly separated in two categories as shown in Fig.4. The Deenbandhu model consumes less surface area than others which results in less installation cost without sacrificing the efficiency.

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During the 12th plan period, about 3.94 lakhbiogas plants have been set up upto 31.12.2016. The estimated average biogas production capacity of these biogas plants is 7.87 lakh cubic meter per day. These biogas plants are helping directly to an estimated annual replacement saving of about 87.5 lakh numbers of LPG cylinders equivalent. Besides that also producing about 35.95 lakh tonnes of organic enriched biomanure per year. The organic bio-manure being produced is equivalent to about 38,000 tonnes of Urea per annum. Alternatively the saving by biogas plants installed during the last four years and during current year 2016-17 (up to 31.12.2016) can replace the use of about 1780 lakhliters of kerosene annually[6] [7]. The installed plants are contributing in saving of about 9.96 lakh tonnes fuelwood per annum, and thereby, helping in preventing emission of about 19,65,000 tonnes of carbon dioxide annually, into the atmosphere[8], [9], [10].

Conclusion:

According to the UN energy security is a prerequisite to achieve the Millennium Development Goals (MDGs) and biogas is one of the means to obtain energy security[11].Upto December, 2016 with the cumulative total installation of about 49.67lakh family type biogas plants about 40.25 % of the total estimated potential based on cattle dung waste only has been harnessed. The direct benefits are on-site farm energy generation, women empowerment, indoor air improvement, sanitation improvement and pathogen removal, chemical fertilizer displacement and nutrient recovery apart from some financial benefits[12][13].

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Table.1. State wise biogas plant installed up to 2016-17 in India [6]

State/ Union Territories	Estimated Potential (Plants in Nos.)	Cumulative achievements up to 2016-17 (in Nos.)	Achievement (%)
Andhra Pradesh	10650000	549235	51.57
Arunachal Pradesh	75000	3555	47.40
Assam	3070000	1303755	42.47
Bihar	7330000	1298444	17.71
Chhattisgarh	4000000	548255	13.71
Goa	80000	42300	52.88
Gujarat	5540000	4333177	78.22
Haryana	3000000	620855	20.70
Himachal Pradesh	1250000	476500	38.12
Jammu & Kashmir	1280000	31663	2.47
Jharkhand	1000000	75759	7.58
Karnataka	6800000	4917644	72.32
Kerala	1500000	1495684	99.71
Madhya Pradesh	14910000	3656893	24.53
Maharashtra	8970000	8994728	100.28
Manipur	380000	21280	5.60
Meghalaya	240000	101962	42.48
Mizoram	50000	54120	108.24
Nagaland	67000	79530	118.70
Odisha	6050000	2708800	44.77
Punjab	4110000	1774445	43.17
Rajasthan	9150000	712315	7.78
Sikkim	73000	90404	123.89
Tamil Nadu	6150000	2228700	36.24
Telengana	-	225915	-
Tripura	280000	36200	12.93
Uttar Pradesh	19380000	4407133	22.74
Uttrakhand	830000	215588	25.97
West Bengal	6950000	3669748	52.80
A&N Islands	22000	13007	6.23
Chandigarh	14000	9607	6.93
Dadra & Nagar Haveli	20000	16909	8.45
Delhi/ New Delhi	1290000	68381	5.28
Puducherry	430000	57308	13.44
Total	**12339300**	**4966628**	**40.25**

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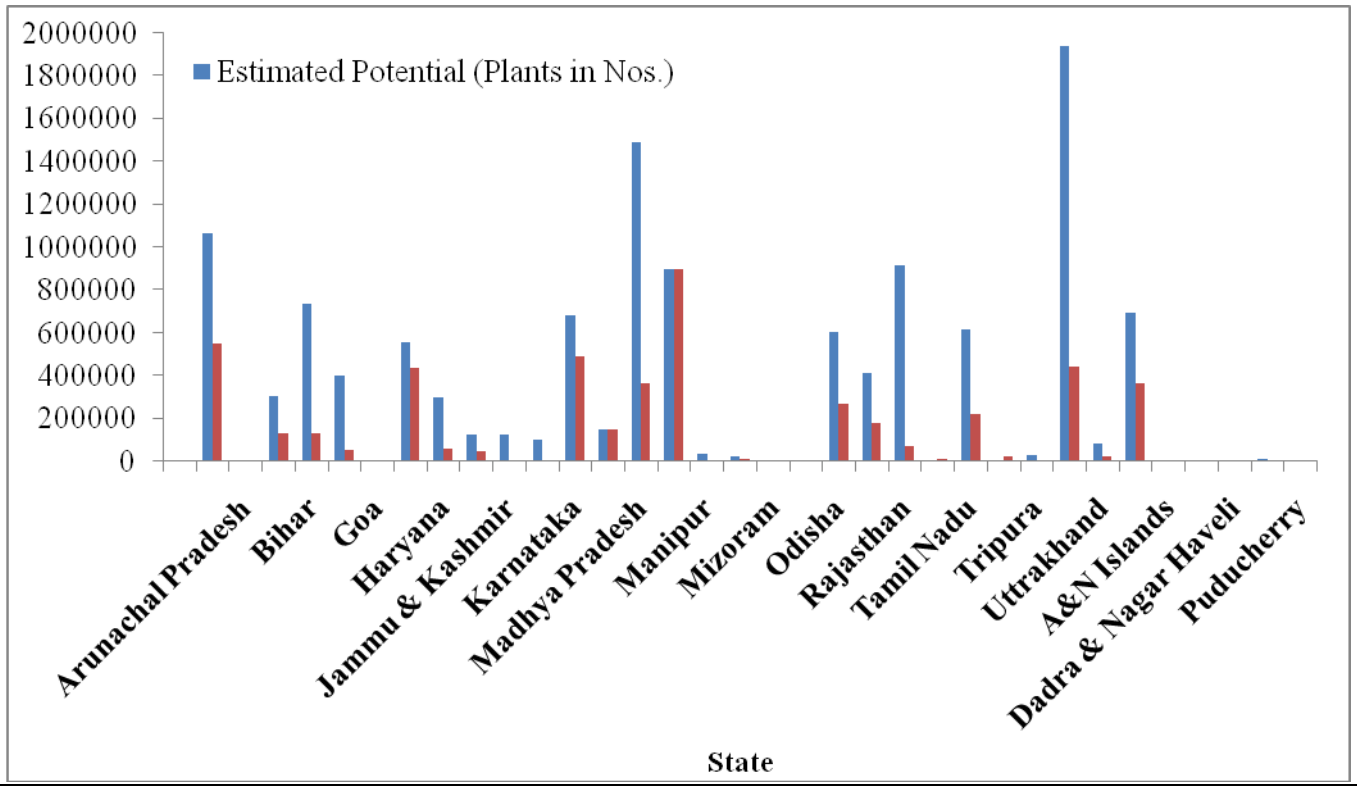

Fig.2. Potential vs. achievement of biogas plant in India

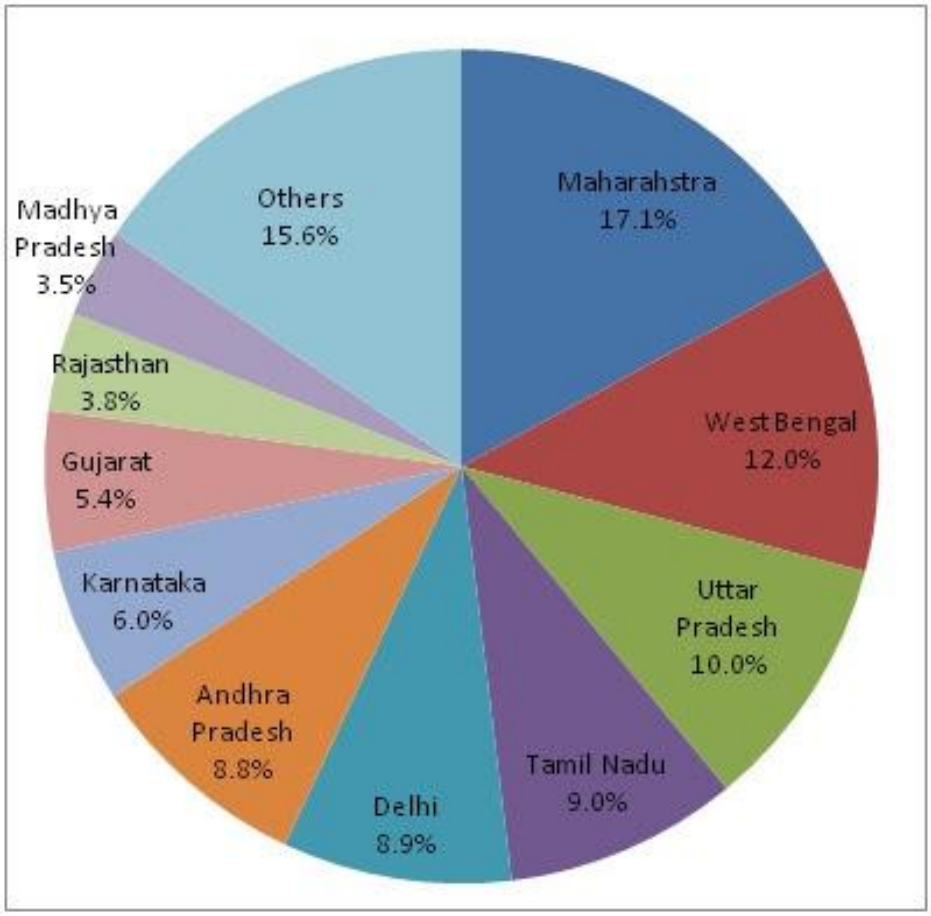

Fig.3. Share of States and Union Territories in Urban MSW Generated

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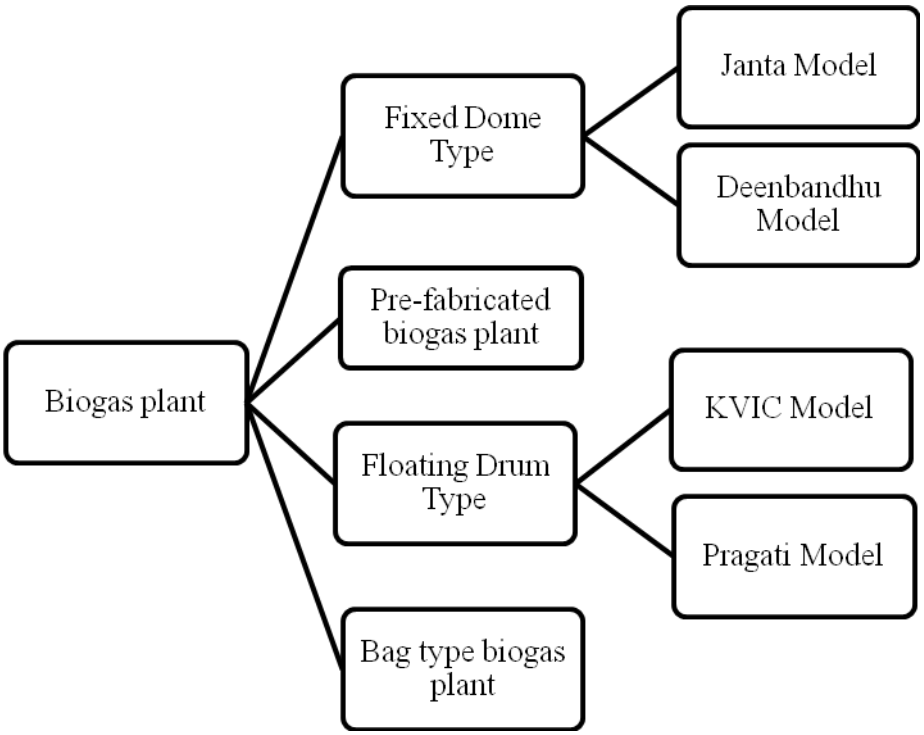

Fig.4. MNRE approved family sized Biogas Plant